DOCUMENT RESUME

ED 474 037 HE 035 670

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TITLE Using Logistic Regression To Find Appropriate Weights for a Simplified Academic Admission Index. AIR 2002 Forum Paper.

PUB DATE 2002-06-00

NOTE 22p.; Paper presented at the Annual Meeting of the Association for Institutional Research (42nd, Toronto, Ontario, Canada, June 2-5, 2002).

PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)

EDRS PRICE EDRS Price MF01/PC01 Plus Postage.

DESCRIPTORS College Admission; *College Freshmen; Decision Making; Higher Education; *Regression (Statistics)

IDENTIFIERS *Admission Index; *Weighting (Statistical)

ABSTRACT

Logistic regression was used to develop appropriate weights for an academic admission index. A combined sample of 3-year freshman cohorts (fall 1996 through fall 1998) was used to develop the index. The weights in several logistic regression analyses for high school class percentile and ACT composite score predicting different college outcomes were taken into consideration to compose a simplified academic admission index. The effectiveness of the index was examined by several outcome measures in the original sample of 6,412 and a validation sample of 2,323. Difference in weights of the composite index existed among academic colleges, suggesting different weights of the composite index should be used in different colleges for recruiting purposes. Results suggest using different weights to compose the index for particular colleges might be more appropriate. (Contains 3 figures, 7 tables, and 17 references.) (Author/SLD)

# Using Logistic Regression to Find Appropriate Weights for a Simplified Academic Admission Index

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# Using Logistic Regression to Find Appropriate Weights for a Simplified Academic Admission Index


## Abstract

Logistic regression was used to develop appropriate weights for an academic admission index. A combined sample of three-year freshman cohorts (fall 1996 through fall 1998) was used to develop the index. The weights in several logistic regression analyses for high school class percentile and ACT composite score predicting different college outcomes were taken consideration to compose a simplified academic admission index. The effectiveness of the index was examined by several outcome measures in the original sample and in a validation sample. Difference in weights of the composite index existed among academic colleges; suggesting different weights of the composite index should be used in different colleges for recruiting purpose. Results suggested using different weights to compose the index for particular colleges might be more appropriate.

Many researchers have noted that academic variable such as high school class percentile (HSCP), high school GPA, high school core courses taken, and standardized test score (ACT, SAT, etc.) can effectively predict college performance (Price & Kim, 1976; Mathiasen, 1984; Mouw & Khanna, 1993; Willingham, 1995; Beecher & Fischer ,1999). Berkner & Chavez's research (1997) noted that "academic qualifications" for college were based on a composite of high school grade point average, high school class rank, and standardized test scores such as SAT and ACT. Being "college qualified"--in other words, being qualified by students' academic preparation in high school, was shown to be very important for college persistence and attainment (Kaufman & Chen, 1999). Many institutions have used a weighted academic admission index for help recruiting new undergraduate students (e.g. Getting into college, 1998; Information on Admissions at Utah's Public Colleges and Universities, 2001). Such index usually consisted of high school academic performance, such as grade point average in high school, high school class rank or percentile, and standardized test scores (SAT, ACT, etc.). There are many weighting methods to combine several predictor variables into a composite index score, such as regression weights (the weight derived from the regression analysis), equal weights (weighting the predictor variable by the reciprocal of it's standard deviation), unit weights (the standard scores of predictor variables are each given weights of 1), factor weights, and canonical weights, etc. (Wang & Stanley, 1970; Aamodt & Kimbrough, 1985). Numerous studies also have been done to develop an academic index to predict college success (e.g. Nicholson, 1971; Whital, 1984; Rowe et. al., 1985). Thornell & Jones (1986) used regression analysis to establish a prediction equation for college freshman GPA using ACT and HSCP as predictor variables. They

found that although the ACT did contribute to the prediction equation to predict freshman GPA, high school performance was a better predictor than ACT. Most studies on prediction effectiveness of high school GPA, class percentile and standardized test score predicting college performance used college GPA as dependent variable, thus only students who persisted in college retained in their analysis. Xiao (1999) followed 6,593 freshmen and found that academic success was among the best academic indicators for later persistence and bachelor's degree completion. Every student who enrolled at the beginning of the first semester in college retained in that study. Using the second and fourth semester academic success to predict college graduation (in six years) achieved 70.7% and 80.1% correct predictions, respectively. Xiao also found that HSCP was a better predictor than ACT scores for predicting student success in college. Osborne (2000) stated that multiple regression could be an effective tool for developing prediction equations. Osborne encouraged the use of logistic regression for predicting binomial or discrete outcomes in future research. The present study used logistic regression analysis to develop and evaluate a simplified academic admission index to predict college academic success. The index is the sum of HSCP and a weighted ACT. The basic goal of the present study is to find the appropriate weights for the index, enable it to predict college success effectively.

## Method

### *Students*

Table 1 shows the demographics of student samples in the present study. The original sample had 6,412 new freshmen that entered in a Midwest university in fall

Table 1
Demographics of Freshmen Cohorts

| | | Fall 1996-98 Combined | Fall 1999 |
|---|---|---|---|
| College | Business | 1,482 | 536 |
| | Education | 476 | 214 |
| | Engineering & Engineering Tech | 438 | 208 |
| | Health & Human Sciences | 829 | 246 |
| | Liberal Arts & Sciences | 2,654 | 881 |
| | Visual & Performing Arts | 533 | 238 |
| Gender | Female | 3,439 | 1,082 |
| | Male | 2,973 | 1,241 |
| All | | 6,412 | 2,323 |

1996, fall 1997, and fall 1998. Students enrolled in six colleges--Colleges of Business (BUS), Education (EDU), Visual and Performing Arts (ART), Liberal Arts and Sciences (LAS), Health and Human Sciences (HHS), and Engineering and Engineering Technology (EET). The validation sample had 2,323 fall 1999 new freshmen enrolled in the same university. Students without a HCSP or ACT score were not included in these samples. Some students did not have ACT score but SAT score. Their SAT score was converted into appropriate ACT score.

***Data***

Students demographic data, persistent data, cumulative GPA, HSCP, ACT were obtained from student record file. Student academic success is defined that student retained in the end of a semester and received a cumulative GPA of 2.0 or higher. Those students' academic success in that semester was coded 1. If a student does not retain at the end of a semester or the student's cumulative GPA is below 2.0, his/her academic success in that semester was coded 0.

*Analysis Strategies*

Logistic regression was used in the original sample to develop the weighted index, and evaluate the effectiveness of the index. In the initial step of logistic regression analysis, the predictor variables were HSCP and ACT. The dependent variable was success in the second or fourth semester. The ratio of parameters for ACT and HSCP was calculated for each logistic regression. A simple weight for ACT was determined after a comprehensive review of these ratios in different logistic regression equations. Thus the index is simply the sum of HSCP and a weighted ACT. The weight for ACT in the index should be robust over student samples, should be effective to predict different college outcome measures, and be simple. The present study treated success in the second semester more important than success in the fourth semester. Once the weight for ACT in the index was determined, correlation analysis and further logistic regression analysis was conducted. Correlation coefficients were calculated in both original and validation samples to evaluate the associations between indexes score and academic success in the second and fourth semesters. In the logistic regression, the predictor variables was the index, the dependent variable was success in the second or fourth semester. The probability of success was calculated at different cutoff index scores. Proportion of success for students equal or above each cutoff index score and below the cutoff score was calculated for each outcome measures according to the logistic regression results. Chi-square test was used in the validation sample to examine the difference in proportions of academic success between students whose index score was at least equal to a cutoff score, and students whose index score was below the cutoff score. Hit ratio was calculated for the original sample at each index score (probability of correct

decisions) and the validation sample at each range of index score (proportion of correct decisions). The correct decisions include students equal or above index who received success, and students below index who did not receive success.

## Results

The present study showed how to use logistic regression to find appropriate weights for the admission index consists of HSCP and ACT score. The index score could predict several college outcome measures effectively.

### *Logistic Regression to Determine Weights in the Index*

Table 2 shows the chi-square for covariates and parameters in logistic regression for the original sample. All chi-squares were significant ($df = 2, p < .0001$) for HSCP and ACT in predicting the second and fourth semester success for individual colleges and for total freshmen sample. All parameters for HSCP and most parameters for the intercept and ACT were significant ( $p < .05$). The ratio for parameters for ACT and HSCP was 1.6 for predicting success in the second semester and 1.0 for predicting success in the fourth semester. In individual colleges, the ratios ranged from –0.2 (ART) to 3.6 (BUS) for predicting success in the second semester and ranged from –0.5 (ART) to 2.9 (BUS) for predicting success in the fourth semester. The weight for ACT in the admission index determined was 1.5 for the whole freshman sample, as well as, for colleges of EDU, LAS, HHS, and EET. That weight was 2.0 for BUS and 0.0 for ART.

### *Correlation Analysis*

The two outcome measures--success in the second semester and fourth semester correlated significantly ($r = 0.635$, $n = 6{,}412$, $p < 0.0001$ for fall 1996-98 freshmen and

Table 2
Logistic Regression Results of ACT and High School Class Percentile in Predicting College Performance Measures for Fall 1996-98 Combined Cohort

| | $\chi^2$ ( $df$ = 2) | Parameters in Logistic Regression | | | Parameter of ACT/ |
|---|---|---|---|---|---|
| | For Covariates | Intercept | H. S. Class Percentile | ACT | Parameter of HSCP |
| Predicting Success in 2nd Semester | | | | | |
| Business | 129.990 | -4.0488 | 0.0343 | 0.1251 | 3.6 |
| Education | 41.043 | -3.312 | 0.0401 | 0.0811(n.s) | 2.0 |
| Engr & Engr Tech | 66.433 | -4.8224 | 0.0474 | 0.0903 | 1.9 |
| Health & Human Sciences | 81.565 | -3.1331 | 0.0423 | 0.0574 | 1.4 |
| Liberal Arts & Sciences | 214.673 | -2.6365 | 0.0329 | 0.0527 | 1.6 |
| Visual & Performing Arts | 43.602 | -1.1027(n.s) | 0.0409 | -0.0069(n.s) | -0.2 |
| All | 556.781 | -2.8133 | 0.0359 | 0.0587 | 1.6 |
| Predicting Success in 4th Semester | | | | | |
| Business | 96.415 | -3.0114 | 0.0288 | 0.0829 | 2.9 |
| Education | 14.839 | -1.2423(n.s) | 0.0227 | 0.0201(n.s) | 0.9 |
| Engr & Engr Tech | 29.043 | -3.2931 | 0.0266 | 0.0804 | 3.0 |
| Health & Human Sciences | 39.763 | -2.2423 | 0.025 | 0.0544(n.s.) | 2.2 |
| Liberal Arts & Sciences | 188.232 | -1.9012 | 0.0314 | 0.0141 | 0.4 |
| Visual & Performing Arts | 39.553 | -1.1022(n.s) | 0.0351 | -0.0161(n.s.) | -0.5 |
| All | 397.018 | -2.0089 | 0.0295 | 0.0289 | 1.0 |

Note: $p < .0001$ for all $\chi 2$ for covariates, $p < .05$ for all parameters in logistic regression, excerpt for those marked non significant (ns).

$r = 0.660$, $n = 2,323$, $p < 0.0001$ for fall 1999 freshmen). Table 3 shows that the index is significantly correlated with students' second semester and fourth semester academic success ($p < 0.05$ for all correlation coefficients), in both the original and the validation freshman samples. In each student group, correlation coefficient between the index and success in the second semester was higher than that between the index and success in the fourth semester. With a few exceptions, the correlation coefficients between the index and academic success variables were higher than the correlation coefficients between HSCP and academic success variables. The correlation coefficient between the index (or HSCP) and performance measures were always higher than the corresponding correlation coefficient between ACT and performance measures.

### *Logistic Regression to Evaluate the Effectiveness of the Index*

Table 4 shows the chi-square for covariates and parameters in logistic regression for the original sample. All chi-squares were significant ($df = 1, p < .0001$) for the index

## Table 3
## Correlation Coefficients Between Index, H.S. Class percentile, ACT Composite and Performance Measures

| | | Index | H.S. Class Percentile | ACT |
|---|---|---|---|---|
| Fall 1996-98 Combined Cohort (Concurrent) | | | | |
| Business (n = 1,482) | | | | |
| | Success in 2nd semester | 0.286 | 0.263 | 0.158 |
| | Success in 4th Semester | 0.250 | 0.235 | 0.124 |
| Education (n = 476) | | | | |
| | Success in 2nd semester | 0.285 | 0.279 | 0.148 |
| | Success in 4th Semester | 0.174 | 0.174 | 0.076 (ns) |
| Engr & Engr Tech(n = 438) | | | | |
| | Success in 2nd semester | 0.378 | 0.359 | 0.177 |
| | Success in 4th Semester | 0.248 | 0.224 | 0.154 |
| Health & Human Sciences (n = 829) | | | | |
| | Success in 2nd semester | 0.310 | 0.310 | 0.152 |
| | Success in 4th Semester | 0.217 | 0.211 | 0.130 |
| Liberal Arts & Sciences (n = 2,654) | | | | |
| | Success in 2nd semester | 0.280 | 0.272 | 0.113 |
| | Success in 4th Semester | 0.259 | 0.263 | 0.066 |
| Visual & Performing Arts (n = 533) | | | | |
| | Success in 2nd semester | 0.286 | 0.286 | 0.057 |
| | Success in 4th Semester | 0.270 | 0.270 | 0.073 (ns) |
| All (n = 6,412) | | | | |
| | Success in 2nd semester | 0.290 | 0.283 | 0.122 |
| | Success in 4th Semester | 0.245 | 0.244 | 0.086 |
| Fall 1999 Cohort (Cross-Validation) | | | | |
| Business (n = 536) | | | | |
| | Success in 2nd semester | 0.185 | 0.169 | 0.111 |
| | Success in 4th Semester | 0.145 | 0.139 | 0.069 (ns) |
| Education (n = 214) | | | | |
| | Success in 2nd semester | 0.297 | 0.274 | 0.204 |
| | Success in 4th Semester | 0.138 | 0.143 | 0.033 (ns) |
| Engr & Engr Tech(n = 208) | | | | |
| | Success in 2nd semester | 0.426 | 0.420 | 0.130 (ns) |
| | Success in 4th Semester | 0.351 | 0.361 | 0.047 (ns) |
| Health & Human Sciences (n = 246) | | | | |
| | Success in 2nd semester | 0.175 | 0.178 | 0.055 (ns) |
| | Success in 4th Semester | 0.186 | 0.196 | 0.031 (ns) |
| Liberal Arts & Sciences (n = 881) | | | | |
| | Success in 2nd semester | 0.287 | 0.282 | 0.118 |
| | Success in 4th Semester | 0.228 | 0.217 | 0.119 |
| Visual & Performing Arts (n = 238) | | | | |
| | Success in 2nd semester | 0.243 | 0.243 | 0.097 (ns) |
| | Success in 4th Semester | 0.181 | 0.181 | 0.080 (ns) |
| All (n = 2,323) | | | | |
| | Success in 2nd semester | 0.256 | 0.252 | 0.100 |
| | Success in 4th Semester | 0.202 | 0.203 | 0.065 |

Note: 1. $p < .05$ for all correlation coefficients, excerpt for those marked non significant (ns).

2. Index = High School Class percentile + 2..0*ACT for College of Business,
Index = High School Class percentile for College of Visual & Performing Arts,
Index = High School Class percentile + 1..5*ACT for all other colleges and all.

Table 4

**Logistic Regression Results of Index Score Predicting College Performance Measures For Fall 1999 Cohort**

| | $\chi^2$ ( $df$ = 1) | Parameters in Logistic Regression | | Weight for ACT |
|---|---|---|---|---|
| | For Covariates | Intercept | Index | in Index |
| Predicting Success in 2nd Semester | | | | |
| Business | 125.093 | -3.0739 | 0.0369 | 2.0 |
| Visual & Performing Arts | 43.553 | -1.2329 | 0.0404 | 0.0 |
| All | 556.567 | -2.7311 | 0.0362 | 1.5 |
| Predicting Success in 4th Semester | | | | |
| Business | 95.264 | -2.5898 | 0.0301 | 2.0 |
| Visual & Performing Arts | 39.208 | -1.3988 | 0.0339 | 0.0 |
| All | 394.597 | -2.582 | 0.0285 | 1.5 |

Note: $p < .0001$ for all $\chi 2$ for covariates, $p < .001$ for all parameters in logistic regression.

predicting the second and fourth semester success in BUS, ART, and in total freshmen sample. All parameters in these logistic regressions were significant at the .001 level. The left portion of Tables 5 through 7 shows the results derived from logistic regression. Probability of success was calculated at different cutoff index scores. For example, in the first column of Table 5, the corresponding probability of success for index 100 is 0.708 and 0.644 for success in the second and fourth semester, respectively. That means the probability to receive the second and fourth semester success is 0.708 and 0.644, respectively, for student whose index equals to 100. The following two columns show the probability of success for students equal and above each cutoff score and students below that cutoff score. The last column of the left portion in tables 5 through 7 shows the probability of correct decisions (hit ratios) using each cutoff index score. The highest probability of correct decisions (hit ratio) would be obtained by using an index score 75 or 80 as cutoff score for the whole freshmen sample (Table 5), an index score 85 or 90 as cutoff score in BUS (Table 6) and an index score 30 or 35 as cutoff score in ART (Table 7).

*Validating in Validation sample*

The right portion of Tables 5 through 7 shows the real data calculation results in the validation sample. Proportion of success was calculated in each cutoff index score ranges, instead of at each cutoff score. For example, in the right portion of Table 5, the corresponding proportion of success in the row for index 100 is 0.661 and 0.648, for fall 1999 freshmen success in the second and fourth semester, respectively. That means 66.1% and 64.8% of students whose index is at least 100 but below 105 experienced second semester and fourth semester success, respectively. The next two columns show the proportion of success for students equal and above each cutoff score and students below the cutoff score, respectively. Chi-square test revealed that the difference in proportion of academic success was significant between students whose Index score was at least at the cutoff score and students whose index score was below that cutoff score when certain cutoff scores were used ($df = 1, p < .001$ for all $\chi^2$s). The last column in tables 5 through 7 shows the proportion of correct decisions (hit ratios) using each cutoff index score. The highest hit ratio was obtained when a cutoff score of 65 was used for the validation sample The cutoff score that could achieve the highest hit ratio in the validation sample was slightly lower than that in the original sample. That also was true for BUS and ART. Figures 1 through 3 compare the probability of success derived from logistic regression in the original sample (fall 1996-98), and the actual proportion of success in the validating sample. The trend of the two curves is similar, even though the curve for fall 1999 actual data is a zigzag line. The predicted probability of success was lower than the actual proportion of success in the lower index levels for students in BUS (Figure 2). Figures 1 through 3, also, show the curve for proportion of students who

Table 5

Efficiency of Index Predicting Academic Success for All Freshmen

| | Fall 1996-98 Combined Cohort (Calculated from Logistic Regression) | | | | | Fall 1999 Cohort (Real Data) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index | Probability of Success | Equal or Above Cutoff Score | Below Cutoff Score | Difference in Probability of Success | Probability of Correct Decision (Hit Ratio) | Proportion of Success | Equal or Above Cutoff Score | Below Cutoff Score | Difference in Proportion of Success | $\chi 2$ | $p$ | Proportion of Correct Decision (Hit Ratio) |
| Predicting Success in Second Semester: | | | | | | | | | | | | |
| 150 | 0.937 | 0.937 | 0.694 | 0.243 | 0.306 | 1.000 | 1.000 | 0.720 | 0.280 | 1.167 | 0.028 | 0.281 |
| 145 | 0.925 | 0.926 | 0.693 | 0.233 | 0.309 | 0.900 | 0.923 | 0.719 | 0.204 | 2.670 | 0.102 | 0.285 |
| 140 | 0.912 | 0.914 | 0.690 | 0.224 | 0.319 | 0.960 | 0.947 | 0.716 | 0.231 | 9.894 | 0.002 | 0.294 |
| 135 | 0.896 | 0.903 | 0.685 | 0.218 | 0.338 | 0.933 | 0.939 | 0.711 | 0.228 | 24.259 | 0.001 | 0.317 |
| 130 | 0.878 | 0.892 | 0.678 | 0.213 | 0.364 | 0.918 | 0.928 | 0.701 | 0.227 | 45.708 | 0.001 | 0.352 |
| 125 | 0.857 | 0.875 | 0.665 | 0.210 | 0.409 | 0.835 | 0.890 | 0.692 | 0.198 | 54.808 | 0.001 | 0.390 |
| 120 | 0.833 | 0.860 | 0.649 | 0.212 | 0.460 | 0.848 | 0.877 | 0.680 | 0.197 | 73.469 | 0.001 | 0.435 |
| 115 | 0.807 | 0.846 | 0.631 | 0.215 | 0.509 | 0.829 | 0.864 | 0.664 | 0.200 | 93.309 | 0.001 | 0.485 |
| 110 | 0.777 | 0.830 | 0.611 | 0.219 | 0.556 | 0.797 | 0.847 | 0.644 | 0.203 | 111.729 | 0.001 | 0.540 |
| 105 | 0.744 | 0.814 | 0.588 | 0.225 | 0.600 | 0.760 | 0.830 | 0.623 | 0.207 | 122.569 | 0.001 | 0.590 |
| 100 | 0.708 | 0.797 | 0.564 | 0.233 | 0.637 | 0.661 | 0.800 | 0.614 | 0.186 | 97.264 | 0.001 | 0.622 |
| 95 | 0.669 | 0.780 | 0.539 | 0.241 | 0.666 | 0.750 | 0.793 | 0.579 | 0.214 | 118.625 | 0.001 | 0.666 |
| 90 | 0.628 | 0.762 | 0.512 | 0.250 | 0.687 | 0.595 | 0.771 | 0.574 | 0.197 | 85.224 | 0.001 | 0.682 |
| 85 | 0.585 | 0.744 | 0.480 | 0.264 | 0.702 | 0.598 | 0.756 | 0.565 | 0.191 | 63.576 | 0.001 | 0.696 |
| 80 | 0.541 | 0.728 | 0.447 | 0.282 | 0.707 | 0.573 | 0.743 | 0.561 | 0.182 | 41.739 | 0.001 | 0.705 |
| 75 | 0.495 | 0.715 | 0.408 | 0.307 | 0.707 | 0.577 | 0.733 | 0.548 | 0.185 | 26.244 | 0.001 | 0.713 |
| 70 | 0.450 | 0.706 | 0.365 | 0.341 | 0.703 | 0.527 | 0.727 | 0.565 | 0.161 | 11.417 | 0.001 | 0.715 |
| 65 | 0.406 | 0.700 | 0.323 | 0.378 | 0.700 | 0.733 | 0.727 | 0.404 | 0.322 | 23.761 | 0.001 | 0.724 |
| 60 | 0.363 | 0.698 | 0.284 | 0.414 | 0.698 | 0.444 | 0.724 | 0.379 | 0.345 | 16.933 | 0.001 | 0.723 |
| 55 | 0.323 | 0.696 | 0.249 | 0.447 | 0.696 | 0.385 | 0.723 | 0.375 | 0.348 | 9.526 | 0.002 | 0.722 |
| 50 | 0.284 | 0.695 | 0.224 | 0.471 | 0.695 | 0.400 | 0.722 | 0.364 | 0.358 | 6.973 | 0.008 | 0.721 |
| 45 | 0.249 | 0.695 | 0.197 | 0.498 | 0.695 | 0.167 | 0.720 | 0.600 | 0.120 | 0.359 | 0.549 | 0.720 |
| 40 | 0.217 | 0.694 | 0.163 | 0.532 | 0.694 | 1.000 | 0.721 | 0.000 | 0.721 | 5.152 | 0.023 | 0.721 |
| 35 | 0.188 | 0.694 | 0.150 | 0.544 | 0.694 | 0.000 | 0.720 | -- | -- | -- | -- | 0.720 |
| Predicting Success in Fourth Semester: | | | | | | | | | | | | |
| 150 | 0.883 | 0.883 | 0.639 | 0.244 | 0.362 | 1.000 | 1.000 | 0.675 | 0.325 | 1.444 | 0.230 | 0.326 |
| 145 | 0.867 | 0.869 | 0.638 | 0.231 | 0.364 | 0.900 | 0.923 | 0.674 | 0.249 | 3.658 | 0.056 | 0.329 |
| 140 | 0.850 | 0.853 | 0.635 | 0.218 | 0.373 | 0.920 | 0.921 | 0.671 | 0.250 | 10.632 | 0.001 | 0.338 |
| 135 | 0.831 | 0.840 | 0.630 | 0.210 | 0.388 | 0.817 | 0.857 | 0.667 | 0.190 | 15.412 | 0.001 | 0.355 |
| 130 | 0.810 | 0.826 | 0.624 | 0.202 | 0.409 | 0.814 | 0.836 | 0.661 | 0.175 | 25.006 | 0.001 | 0.381 |
| 125 | 0.787 | 0.808 | 0.612 | 0.196 | 0.446 | 0.759 | 0.805 | 0.654 | 0.151 | 29.197 | 0.001 | 0.411 |
| 120 | 0.762 | 0.791 | 0.597 | 0.194 | 0.486 | 0.762 | 0.791 | 0.645 | 0.146 | 36.918 | 0.001 | 0.445 |
| 115 | 0.735 | 0.776 | 0.582 | 0.195 | 0.523 | 0.800 | 0.794 | 0.629 | 0.164 | 57.970 | 0.001 | 0.490 |
| 110 | 0.706 | 0.760 | 0.564 | 0.196 | 0.559 | 0.747 | 0.782 | 0.612 | 0.170 | 72.014 | 0.001 | 0.536 |
| 105 | 0.676 | 0.744 | 0.545 | 0.199 | 0.590 | 0.715 | 0.768 | 0.593 | 0.175 | 81.116 | 0.001 | 0.577 |
| 100 | 0.644 | 0.728 | 0.525 | 0.203 | 0.616 | 0.648 | 0.747 | 0.580 | 0.167 | 72.438 | 0.001 | 0.607 |
| 95 | 0.611 | 0.713 | 0.505 | 0.207 | 0.635 | 0.681 | 0.738 | 0.554 | 0.185 | 81.018 | 0.001 | 0.639 |
| 90 | 0.576 | 0.697 | 0.483 | 0.213 | 0.648 | 0.538 | 0.716 | 0.559 | 0.157 | 49.798 | 0.001 | 0.645 |
| 85 | 0.541 | 0.681 | 0.458 | 0.223 | 0.655 | 0.573 | 0.703 | 0.553 | 0.150 | 36.136 | 0.001 | 0.656 |
| 80 | 0.506 | 0.667 | 0.432 | 0.236 | 0.655 | 0.559 | 0.693 | 0.550 | 0.143 | 23.617 | 0.001 | 0.663 |
| 75 | 0.470 | 0.656 | 0.401 | 0.255 | 0.652 | 0.545 | 0.685 | 0.554 | 0.131 | 11.979 | 0.001 | 0.668 |
| 70 | 0.435 | 0.648 | 0.367 | 0.281 | 0.648 | 0.554 | 0.680 | 0.554 | 0.126 | 6.405 | 0.011 | 0.671 |
| 65 | 0.400 | 0.644 | 0.333 | 0.310 | 0.644 | 0.711 | 0.681 | 0.404 | 0.277 | 16.090 | 0.001 | 0.679 |
| 60 | 0.366 | 0.642 | 0.302 | 0.339 | 0.642 | 0.389 | 0.679 | 0.414 | 0.265 | 9.169 | 0.002 | 0.678 |
| 55 | 0.334 | 0.640 | 0.273 | 0.367 | 0.641 | 0.462 | 0.678 | 0.375 | 0.303 | 6.633 | 0.010 | 0.677 |
| 50 | 0.303 | 0.640 | 0.252 | 0.387 | 0.640 | 0.400 | 0.677 | 0.364 | 0.313 | 4.901 | 0.027 | 0.677 |
| 45 | 0.274 | 0.639 | 0.228 | 0.411 | 0.639 | 0.333 | 0.676 | 0.400 | 0.276 | 1.734 | 0.188 | 0.676 |
| 40 | 0.246 | 0.639 | 0.198 | 0.441 | 0.639 | 0.667 | 0.676 | 0.000 | 0.676 | 4.165 | 0.041 | 0.676 |
| 35 | 0.221 | 0.639 | 0.187 | 0.452 | 0.639 | 0.000 | 0.675 | -- | -- | -- | -- | 0.675 |

Note: Index = High School Class Percentile + 1.5 * ACT.

Hit Ratio = (Number of students equal or above index who achieved success + number of students equal or above index who did not achieve success) / total number of students.

## Table 6
## Efficiency of Index Predicting Academic Success for College of Business Freshmen

| | Fall 1996-98 Combined Cohort (Calculated from Logistic Regression) | | | | | Fall 1999 Cohort (Real Data) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index | Probability of Success | Equal or Above Cutoff Score | Below Cutoff Score | Difference in Probability of Success | Probability of Correct Decision (Hit Ratio) | Proportion of Success | Equal or Above Cutoff Score | Below Cutoff Score | Difference in proportion of Success | $\chi 2$ | $p$ | Proportion of Correct Decision (Hit Ratio) |
| Predicting Success in Second Semester: | | | | | | | | | | | | |
| 165 | 0.953 | 0.953 | 0.725 | 0.229 | 0.276 | | | | | | | |
| 160 | 0.944 | 0.949 | 0.724 | 0.225 | 0.278 | 0.667 | 0.667 | 0.756 | -0.089 | 0.129 | 0.719 | 0.246 |
| 155 | 0.934 | 0.938 | 0.723 | 0.215 | 0.283 | 1.000 | 0.889 | 0.753 | 0.136 | 0.881 | 0.348 | 0.257 |
| 150 | 0.921 | 0.928 | 0.720 | 0.208 | 0.296 | 1.000 | 0.929 | 0.751 | 0.178 | 2.329 | 0.127 | 0.267 |
| 145 | 0.907 | 0.918 | 0.715 | 0.202 | 0.315 | 1.000 | 0.964 | 0.744 | 0.220 | 6.967 | 0.008 | 0.293 |
| 140 | 0.890 | 0.904 | 0.707 | 0.198 | 0.350 | 0.850 | 0.917 | 0.740 | 0.177 | 7.407 | 0.006 | 0.319 |
| 135 | 0.871 | 0.890 | 0.693 | 0.197 | 0.400 | 0.806 | 0.873 | 0.735 | 0.138 | 6.965 | 0.008 | 0.354 |
| 130 | 0.849 | 0.877 | 0.677 | 0.199 | 0.455 | 0.867 | 0.871 | 0.721 | 0.150 | 11.627 | 0.001 | 0.416 |
| 125 | 0.823 | 0.863 | 0.660 | 0.203 | 0.508 | 0.780 | 0.848 | 0.714 | 0.134 | 11.138 | 0.001 | 0.459 |
| 120 | 0.795 | 0.848 | 0.639 | 0.209 | 0.561 | 0.850 | 0.849 | 0.698 | 0.151 | 15.609 | 0.001 | 0.511 |
| 115 | 0.763 | 0.834 | 0.619 | 0.215 | 0.604 | 0.755 | 0.829 | 0.687 | 0.142 | 14.695 | 0.001 | 0.562 |
| 110 | 0.728 | 0.817 | 0.593 | 0.223 | 0.648 | 0.678 | 0.801 | 0.689 | 0.112 | 8.761 | 0.003 | 0.601 |
| 105 | 0.690 | 0.800 | 0.565 | 0.234 | 0.683 | 0.714 | 0.791 | 0.684 | 0.107 | 7.415 | 0.006 | 0.634 |
| 100 | 0.649 | 0.784 | 0.538 | 0.246 | 0.706 | 0.767 | 0.789 | 0.657 | 0.132 | 9.460 | 0.002 | 0.677 |
| 95 | 0.606 | 0.767 | 0.503 | 0.264 | 0.724 | 0.632 | 0.775 | 0.667 | 0.108 | 5.008 | 0.025 | 0.696 |
| 90 | 0.562 | 0.753 | 0.466 | 0.287 | 0.732 | 0.743 | 0.773 | 0.623 | 0.150 | 6.558 | 0.010 | 0.728 |
| 85 | 0.516 | 0.743 | 0.430 | 0.313 | 0.733 | 0.583 | 0.764 | 0.649 | 0.115 | 2.462 | 0.117 | 0.735 |
| 80 | 0.470 | 0.734 | 0.386 | 0.349 | 0.731 | 0.750 | 0.763 | 0.600 | 0.163 | 3.438 | 0.064 | 0.746 |
| 75 | 0.424 | 0.729 | 0.334 | 0.396 | 0.729 | 0.692 | 0.761 | 0.500 | 0.261 | 4.342 | 0.037 | 0.756 |
| 70 | 0.380 | 0.729 | 0.319 | 0.409 | 0.728 | 0.500 | 0.758 | 0.500 | 0.258 | 2.147 | 0.143 | 0.756 |
| 65 | 0.337 | 0.726 | 0.279 | 0.447 | 0.726 | 0.500 | 0.758 | 0.500 | 0.258 | 1.426 | 0.232 | 0.756 |
| 60 | 0.297 | 0.726 | 0.260 | 0.465 | 0.726 | -- | 0.758 | 0.500 | 0.258 | 0.324 | 0.569 | 0.756 |
| 55 | 0.260 | -- | -- | -- | -- | 0.500 | 0.756 | -- | -- | -- | -- | 0.756 |
| Predicting Success in Fourth Semester: | | | | | | | | | | | | |
| 165 | 0.915 | 0.915 | 0.676 | 0.239 | 0.325 | | | | | | | |
| 160 | 0.902 | 0.909 | 0.675 | 0.233 | 0.326 | 0.667 | 0.667 | 0.724 | -0.058 | 0.049 | 0.824 | 0.278 |
| 155 | 0.888 | 0.894 | 0.674 | 0.220 | 0.331 | 1.000 | 0.889 | 0.721 | 0.168 | 1.247 | 0.264 | 0.289 |
| 150 | 0.873 | 0.881 | 0.671 | 0.210 | 0.342 | 1.000 | 0.857 | 0.720 | 0.137 | 1.277 | 0.258 | 0.295 |
| 145 | 0.855 | 0.868 | 0.667 | 0.202 | 0.359 | 1.000 | 0.893 | 0.715 | 0.178 | 4.220 | 0.040 | 0.317 |
| 140 | 0.835 | 0.852 | 0.658 | 0.194 | 0.390 | 0.850 | 0.813 | 0.715 | 0.097 | 2.071 | 0.150 | 0.332 |
| 135 | 0.813 | 0.836 | 0.646 | 0.190 | 0.431 | 0.806 | 0.810 | 0.709 | 0.101 | 3.448 | 0.063 | 0.368 |
| 130 | 0.789 | 0.820 | 0.631 | 0.190 | 0.477 | 0.867 | 0.823 | 0.694 | 0.128 | 7.862 | 0.005 | 0.425 |
| 125 | 0.763 | 0.806 | 0.615 | 0.191 | 0.520 | 0.780 | 0.818 | 0.682 | 0.136 | 10.606 | 0.001 | 0.472 |
| 120 | 0.735 | 0.790 | 0.596 | 0.194 | 0.563 | 0.850 | 0.815 | 0.668 | 0.147 | 13.679 | 0.001 | 0.517 |
| 115 | 0.705 | 0.776 | 0.579 | 0.197 | 0.596 | 0.755 | 0.791 | 0.662 | 0.129 | 11.111 | 0.001 | 0.556 |
| 110 | 0.673 | 0.759 | 0.557 | 0.202 | 0.629 | 0.678 | 0.776 | 0.648 | 0.128 | 10.554 | 0.001 | 0.603 |
| 105 | 0.639 | 0.743 | 0.533 | 0.210 | 0.655 | 0.714 | 0.752 | 0.667 | 0.085 | 4.328 | 0.037 | 0.614 |
| 100 | 0.603 | 0.729 | 0.511 | 0.218 | 0.671 | 0.767 | 0.739 | 0.679 | 0.060 | 1.792 | 0.181 | 0.634 |
| 95 | 0.567 | 0.713 | 0.481 | 0.231 | 0.682 | 0.632 | 0.732 | 0.688 | 0.044 | 0.774 | 0.379 | 0.657 |
| 90 | 0.529 | 0.700 | 0.451 | 0.249 | 0.686 | 0.743 | 0.726 | 0.705 | 0.021 | 0.124 | 0.725 | 0.677 |
| 85 | 0.492 | 0.691 | 0.422 | 0.270 | 0.685 | 0.583 | 0.727 | 0.676 | 0.052 | 0.462 | 0.497 | 0.700 |
| 80 | 0.454 | 0.684 | 0.386 | 0.298 | 0.682 | 0.750 | 0.730 | 0.600 | 0.130 | 2.013 | 0.154 | 0.715 |
| 75 | 0.417 | 0.680 | 0.343 | 0.337 | 0.680 | 0.692 | 0.731 | 0.417 | 0.314 | 5.796 | 0.016 | 0.728 |
| 70 | 0.381 | 0.679 | 0.332 | 0.348 | 0.679 | 0.500 | 0.728 | 0.333 | 0.395 | 4.630 | 0.031 | 0.728 |
| 65 | 0.347 | 0.677 | 0.298 | 0.379 | 0.677 | 0.500 | 0.727 | 0.250 | 0.477 | 4.528 | 0.033 | 0.728 |
| 60 | 0.313 | 0.677 | 0.282 | 0.395 | 0.677 | -- | 0.727 | 0.250 | 0.477 | 2.627 | 0.105 | 0.728 |
| 55 | -- | -- | -- | -- | -- | 0.500 | 0.724 | -- | -- | -- | -- | 0.724 |

Note: Index = High School Class Percentile + 2.0 * ACT.

Hit Ratio = (Number of students equal or above index who achieved success + number of students equal or above index who did not achieve success) / total number of students.

Table 7

Efficiency of Index Predicting Academic Success for College of Visual & Performing Arts Freshmen

| | Fall 1996-98 Combined Cohort (Calculated from Logistic Regression) | | | | | Fall 1999 Cohort (Real Data) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index | Probability of Success | Equal or Above Cutoff Score | Below Cutoff Score | Difference in Probability of Success | Probability of Correct Decision (Hit Ratio) | Proportion of Success | Equal or Above Cutoff Score | Below Cutoff Score | Difference in proportion of Success | $\chi^2$ | $p$ | Proportion of Correct Decision (Hit Ratio) |
| Predicting Success in Second Semester: | | | | | | | | | | | | |
| 95 | 0.931 | 0.931 | 0.772 | 0.160 | 0.256 | 0.929 | 0.929 | 0.772 | 0.156 | 1.884 | 0.170 | 0.269 |
| 90 | 0.917 | 0.923 | 0.761 | 0.162 | 0.311 | 1.000 | 0.967 | 0.755 | 0.212 | 6.892 | 0.009 | 0.336 |
| 85 | 0.901 | 0.914 | 0.749 | 0.165 | 0.367 | 0.769 | 0.907 | 0.754 | 0.153 | 4.838 | 0.028 | 0.366 |
| 80 | 0.881 | 0.904 | 0.735 | 0.169 | 0.428 | 0.941 | 0.917 | 0.736 | 0.181 | 8.582 | 0.005 | 0.429 |
| 75 | 0.858 | 0.888 | 0.707 | 0.181 | 0.528 | 0.870 | 0.904 | 0.716 | 0.187 | 11.128 | 0.001 | 0.500 |
| 70 | 0.832 | 0.878 | 0.686 | 0.192 | 0.584 | 0.793 | 0.875 | 0.698 | 0.177 | 10.828 | 0.001 | 0.571 |
| 65 | 0.802 | 0.866 | 0.663 | 0.203 | 0.637 | 0.800 | 0.861 | 0.673 | 0.188 | 12.048 | 0.001 | 0.634 |
| 60 | 0.767 | 0.854 | 0.641 | 0.214 | 0.677 | 0.611 | 0.832 | 0.687 | 0.146 | 6.703 | 0.010 | 0.651 |
| 55 | 0.729 | 0.837 | 0.606 | 0.231 | 0.723 | 0.750 | 0.823 | 0.667 | 0.156 | 6.618 | 0.010 | 0.693 |
| 50 | 0.688 | 0.822 | 0.566 | 0.256 | 0.755 | 0.583 | 0.807 | 0.686 | 0.121 | 3.448 | 0.063 | 0.702 |
| 45 | 0.643 | 0.810 | 0.527 | 0.283 | 0.772 | 0.706 | 0.799 | 0.676 | 0.123 | 2.563 | 0.109 | 0.731 |
| 40 | 0.595 | 0.800 | 0.483 | 0.317 | 0.780 | 0.786 | 0.798 | 0.600 | 0.198 | 4.213 | 0.040 | 0.765 |
| 35 | 0.546 | 0.791 | 0.429 | 0.362 | 0.783 | 0.667 | 0.795 | 0.571 | 0.223 | 3.845 | 0.050 | 0.773 |
| 30 | 0.495 | 0.788 | 0.401 | 0.387 | 0.783 | 0.833 | 0.796 | 0.375 | 0.421 | 8.012 | 0.005 | 0.790 |
| 25 | 0.445 | 0.784 | 0.368 | 0.417 | 0.782 | 0.250 | 0.786 | 0.500 | 0.286 | 1.888 | 0.169 | 0.782 |
| 20 | 0.396 | 0.780 | 0.283 | 0.496 | 0.779 | 0.500 | 0.784 | 0.500 | 0.284 | 0.936 | 0.333 | 0.782 |
| 15 | 0.348 | -- | -- | -- | -- | 1.000 | 0.785 | 0.000 | 0.785 | 3.592 | 0.058 | 0.786 |
| 10 | 0.304 | 0.779 | 0.263 | 0.516 | 0.779 | -- | 0.785 | 0.000 | 0.785 | 3.592 | 0.058 | 0.786 |
| 5 | 0.263 | -- | -- | -- | -- | 0.000 | 0.782 | -- | -- | -- | -- | 0.782 |
| Predicting Success in Fourth Semester: | | | | | | | | | | | | |
| 95 | 0.861 | 0.861 | 0.670 | 0.191 | 0.351 | 0.857 | 0.857 | 0.652 | 0.205 | 2.490 | 0.115 | 0.378 |
| 90 | 0.840 | 0.848 | 0.657 | 0.190 | 0.396 | 0.750 | 0.800 | 0.644 | 0.156 | 2.851 | 0.091 | 0.412 |
| 85 | 0.816 | 0.835 | 0.644 | 0.191 | 0.439 | 0.538 | 0.721 | 0.651 | 0.070 | 0.766 | 0.381 | 0.416 |
| 80 | 0.789 | 0.820 | 0.628 | 0.192 | 0.486 | 0.706 | 0.717 | 0.646 | 0.071 | 1.002 | 0.317 | 0.445 |
| 75 | 0.759 | 0.799 | 0.599 | 0.200 | 0.558 | 0.826 | 0.747 | 0.619 | 0.128 | 3.946 | 0.047 | 0.508 |
| 70 | 0.727 | 0.786 | 0.578 | 0.208 | 0.596 | 0.759 | 0.750 | 0.587 | 0.163 | 7.034 | 0.008 | 0.571 |
| 65 | 0.692 | 0.771 | 0.555 | 0.217 | 0.630 | 0.800 | 0.759 | 0.535 | 0.224 | 13.128 | 0.001 | 0.634 |
| 60 | 0.654 | 0.758 | 0.534 | 0.224 | 0.653 | 0.500 | 0.729 | 0.542 | 0.187 | 8.458 | 0.004 | 0.634 |
| 55 | 0.615 | 0.738 | 0.502 | 0.236 | 0.676 | 0.550 | 0.709 | 0.540 | 0.169 | 5.921 | 0.015 | 0.643 |
| 50 | 0.574 | 0.721 | 0.467 | 0.255 | 0.689 | 0.417 | 0.690 | 0.569 | 0.121 | 2.638 | 0.104 | 0.634 |
| 45 | 0.532 | 0.709 | 0.433 | 0.276 | 0.693 | 0.588 | 0.681 | 0.559 | 0.123 | 1.961 | 0.161 | 0.647 |
| 40 | 0.490 | 0.698 | 0.397 | 0.301 | 0.692 | 0.571 | 0.674 | 0.550 | 0.124 | 1.269 | 0.260 | 0.655 |
| 35 | 0.447 | 0.690 | 0.354 | 0.336 | 0.688 | 0.500 | 0.670 | 0.571 | 0.098 | 0.570 | 0.450 | 0.655 |
| 30 | 0.406 | 0.687 | 0.332 | 0.355 | 0.686 | 0.667 | 0.670 | 0.500 | 0.170 | 0.996 | 0.318 | 0.664 |
| 25 | 0.366 | 0.683 | 0.306 | 0.377 | 0.683 | 0.250 | 0.662 | 0.750 | -0.088 | 0.135 | 0.713 | 0.655 |
| 20 | 0.327 | 0.679 | 0.242 | 0.437 | 0.679 | 1.000 | 0.665 | 0.500 | 0.165 | 0.243 | 0.622 | 0.664 |
| 15 | 0.291 | -- | -- | -- | -- | 1.000 | 0.667 | 0.000 | 0.667 | 1.983 | 0.159 | 0.668 |
| 10 | 0.257 | 0.678 | 0.226 | 0.452 | 0.678 | -- | 0.667 | 0.000 | 0.667 | 1.983 | 0.159 | 0.668 |
| 5 | 0.226 | -- | -- | -- | -- | 0.000 | 0.664 | -- | -- | -- | -- | 0.664 |

Note: Index = High School Class Percentile.

Hit Ratio = (Number of students equal or above index who achieved success + number of students equal or above index who did not achieve success) / total number of students.

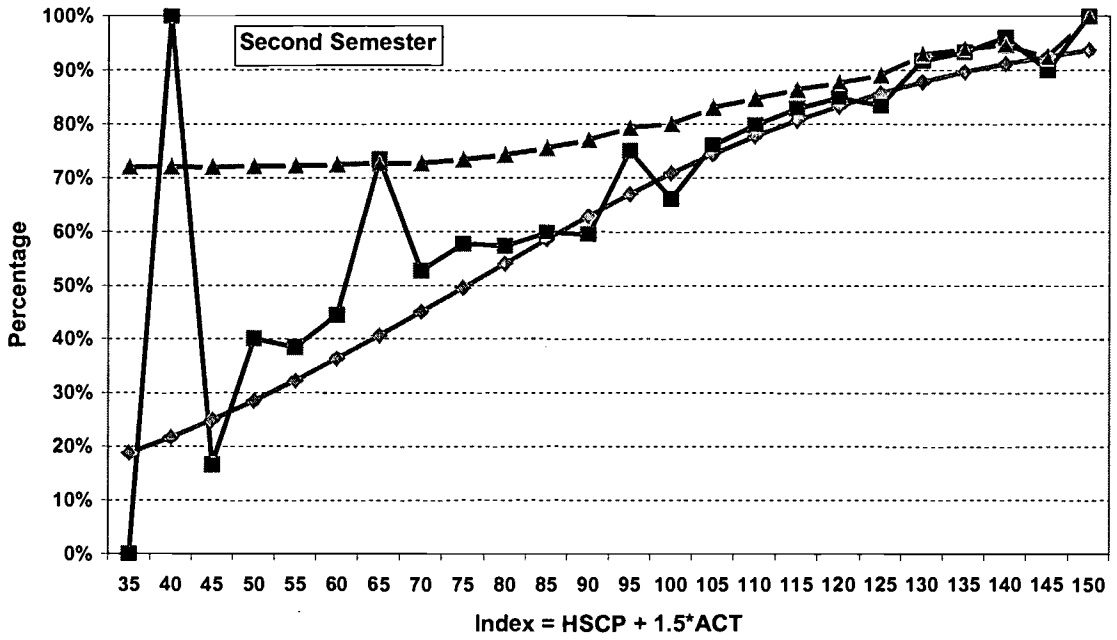
received academic success among students equal or above an index score in the fall 1999 sample. These curves are relatively flat when a lower cutoff index score is used. They show more rapid increase when a cutoff score in the middle or higher range is used. Usually, the higher the cutoff score, the higher the proportion of students receive success.

## Discussion

The present study illustrated the way to develop a simplified academic admission index from parameters in logistic regression. The index is simply a weighted composite score of HSCP and ACT. The present study uses college academic success as college outcome performance measure. Using this dichotomous variable as outcome measure allows all students remain in the analysis. The downside of the dichotomous variable is that may treat students who transferred to other institutions or withdrew from college, who have good college GPA, as not successful in college. This problem can be corrected by carefully following students' reasons to leave the present college. To develop weights in the index, both statistical procedures and subjective determination process are involved. More than one predictor variables and more than one outcome variables are examined. The present study is interested not only in combine predictor variables but also in the accuracy of college success prediction. Researchers (Wainer, 1976; Fralicx & Raju, 1982; Aamodt & Kimbrough,1985) found that most weighting methods were highly related. That is, composite scores derived from different weighting methods were highly correlated. Aamodt & Kimbrough (1985) concluded that "the method used to weight multiple predictors or criteria in the forming of a composite score is not as

important as once believed". The present study determined a simple weight for ACT in the index. The weight was robust over student samples and was effective to predict different college outcome measures. Specifying weight in the index involves subjective process. It must be done with great care. As soon as weights in the index are determined, the probability of success at each index score can be calculated via logistic regression analysis. As seen in the results, in most cases, the actual proportion of success curve in the validation sample almost overlaps the predicted probability of success curve. Proportions of success in BUS in lower index levels were some how under-predicted. It might be due to the possible deference between the validation sample and the original sample in BUS or due to the small number of students in the lower index levels. The present study used two highly correlated outcome measures. The determination of weights in the index has paid more attention on success in the second semester than success in the fourth semester. The results showed that success in the second semester correlated higher with the index score than success in the fourth semester. The index can effectively predict college success. It can help higher education administrators to set the admission criteria and to examine the likelihood of college success of entering students. Results of the study suggested that using different weights to compose the index for particular colleges might be more appropriate. Future research might include more and better predictors and outcome measures to improve the predictive power of the admission index.

Fig. 1: Efficiency of Index Predicting Academic Semester Success for All Freshmen



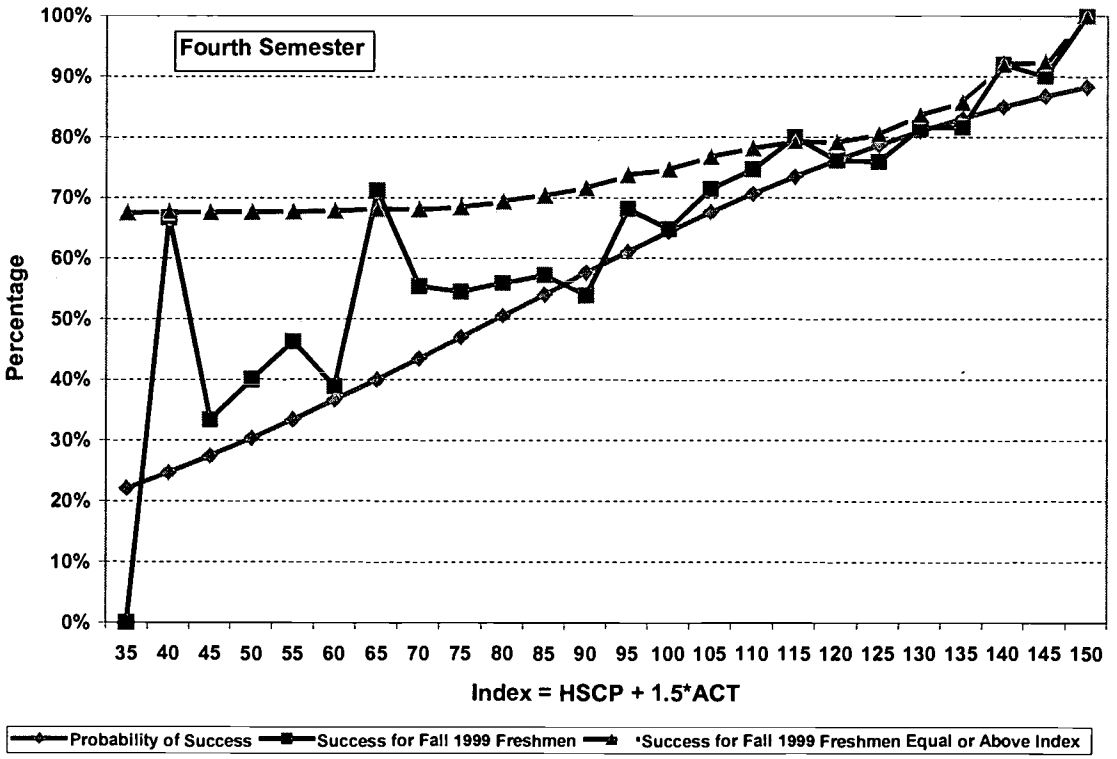
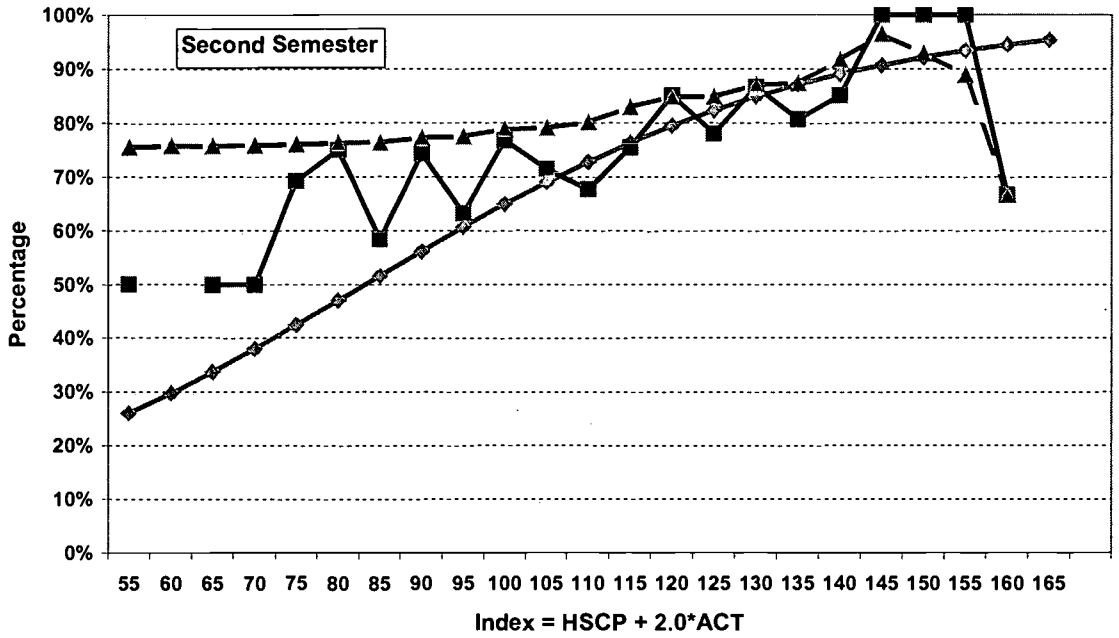



Fig. 2: Efficiency of Index Predicting Academic Success for College of Businness Freshmen



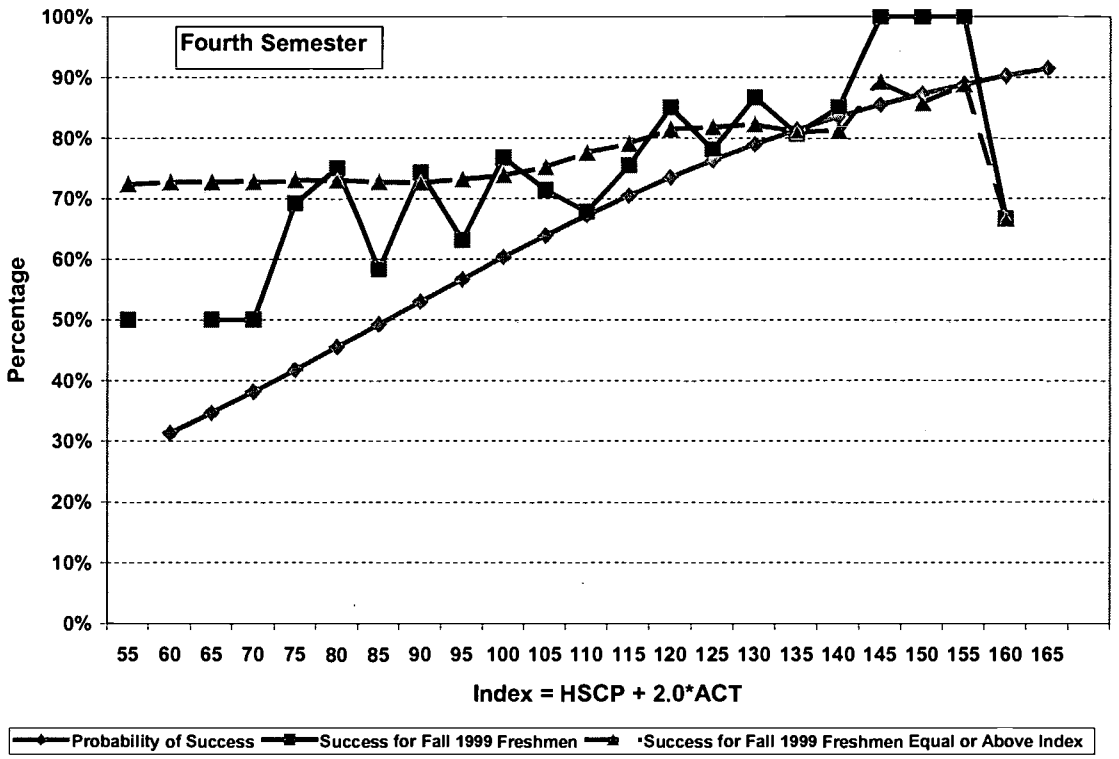
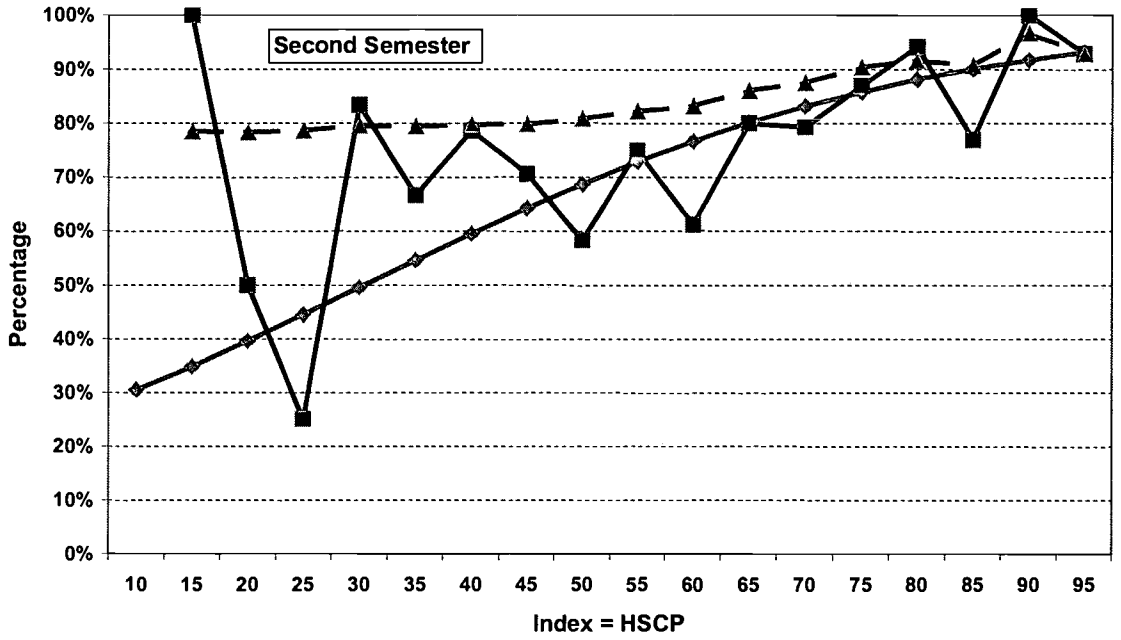
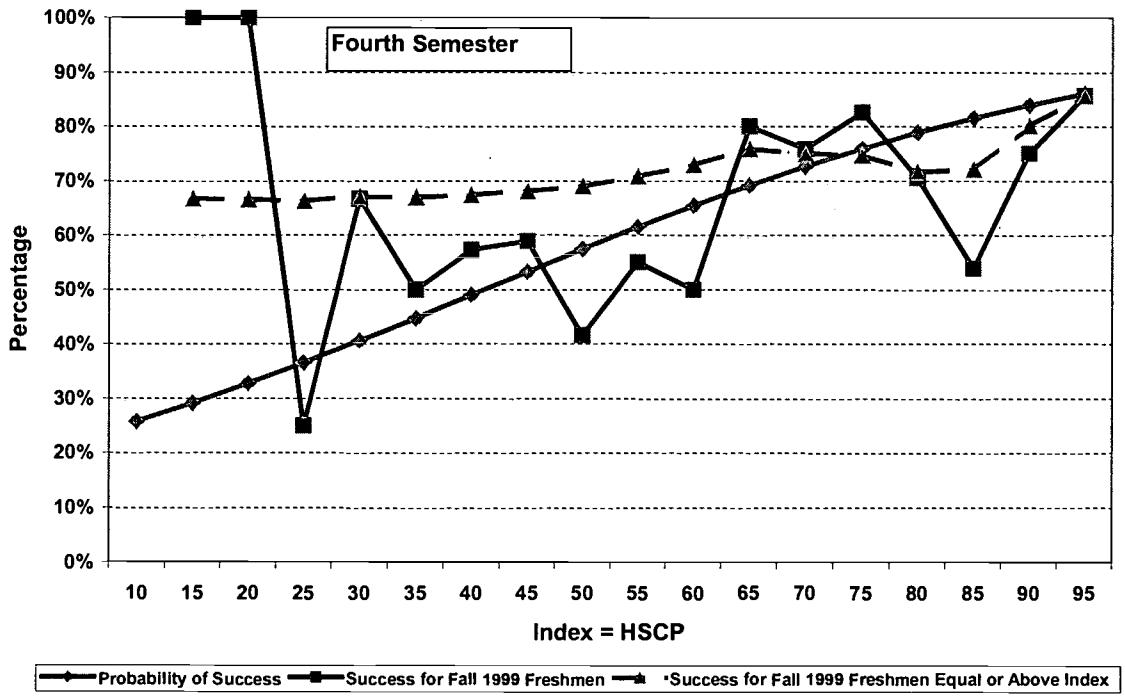



Fig. 3: Efficiency of Index Predicting Academic Success for College of Visual & Performing Arts Freshmen



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